UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/820,312	04/08/2004	Kazunari Oka	S004-5259	7458

40627 7590 07/07/2006

ADAMS & WILKS
17 BATTERY PLACE
SUITE 1231
NEW YORK, NY 10004

EXAMINER	
GEORGE, PATRICIA ANN	
ART UNIT	**PAPER NUMBER**
1765	

DATE MAILED: 07/07/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/820,312	OKA ET AL.	
	Examiner	Art Unit	
	Patricia A. George	1765	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *03 April 2006*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-27* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-27* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Election/Restrictions

Claims 28-33 withdrawn from further consideration pursuant to 37 CFR 1.142(b) as being drawn to a nonelected groups, there being no allowable generic or linking claim. Election was made **without** traverse in the reply filed on April, 30, 2006.

Applicant's election without traverse of claims 1-27 in the reply filed on April 30, 2006 is acknowledged. The requirement is still deemed proper and is therefore made FINAL.

Claim Rejections - 35 USC § 112

The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims 13-14, and 24-25 rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claims 24-26 recites the limitation "the thin film" in line 4 of claim 24, and line 2 of claims 25 and 26. There is insufficient antecedent basis for this limitation in the claim.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and

the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 1-5, 12-15, and 21-22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Zhang (6,682,871) in view of Miller et al. (An Electromagnetic MEMS 2 x 2 Fiber Optic bypass Switch; Cal Tech & Physics Optics Corp; page 2, column 1; 1997).

As to claim 1 Zhang teaches a method of manufacturing a mirror having a reflection surface vertical to the surface of a silicon (col.6, lines 32-36) substrate (see part 502 of figure 5). Zhang teaches a step of forming a mask (figure art 303) to the surface of the substrate (figure 2A, part 304/302/301). Zhang teaches a DRIE step, i.e. (anisotropically dry etching) the substrate (col. 7, lines 49-52), which forms a parallel surface with a crystal face in perpendicular to the surface of the substrate (see figure 5).

Zhang does not teach etching the substrate with an anisotropic wet etching step which forms a mirror (i.e. reflection surface), as in claim 1.

Miller et al. teaches etching the substrate with an anisotropic wet etching step which forms a mirror (i.e. reflection surface) (see page 2, col. 1 and figure 4), as in claim 1.

It would have been obvious to one of ordinary skill in the art at the time of invention was made, to modify the invention of manufacturing a mirror, as Zhang, to include the step of anisotropic wet etching, as Miller, because Miller teaches anisotropic wet silicon etching had demonstrated production of mirrors with superior surface quality (page 2, col.1, lines 7-8).

As to claims 2 and 3, Zhang teaches an angle formed between a portion of a fabrication side wall and the substrate corresponding to the reflection surface and illustrates the surface of the substrate is 90.degree..+/- 0.6 or better (which encompasses applicants' claimed range of 90.degree..+/- .3.degree), in the anisotropic dry etching step, with a surface roughness of 30nm (encompassed by applicants' claimed range of at least 300 nm or less) in the DRIE step (see figure 3C and (col. 8, lines 12-22).

As to claim 4, Zhang teaches a silicon exposed portion is provided to the outer periphery of the substrate in the anisotropic dry etching step (see figures 3A-3F).

As to claim 5, Zhang teaches a cleaning step after the anisotropic dry etching step (see col. 8).

The modified invention of Zhang fails to teach a step of cleaning between the dry and wet anisotropic etching steps.

It would have been obvious to one of ordinary skill in the art at the time of invention was made, to include the step of cleaning, as Zhang, between the dry and wet anisotropic etching steps, as in applicants' claimed limitation, because Zhang teaches the cleaning is effective in removing debris from the dry anisotropic etch step, a known improvement in micro-electronics manufacturing.

As to claim 12 and 15, the modified invention of Zhang teaches the anisotropic wet etchant of TMAH (see Miller, page 2, col. 1) is used to etch silicon (i.e. has the addition of silicon).

As to claim 13, the modified invention of Zhang is silent as to the temperature of the TMAH, 60.degree. C. or higher and 70.degree. C. or lower, as applicants' limitation.

Since the modified invention of Zhang does not limit the temperature of the TMAH, it would have been obvious to one of ordinary skill in the art at the time of invention was made, to select any desirable range, because Zhang does not limit the temperature. One of ordinary skill would select any temperature desired for the anisotropic etch step, including applicants' specifically claim range.

As to claim 14, the modified invention of Zhang is silent as to etching 0.5 .mu.m or more and 3 .mu.m or less with the TMAH wet chemistry.

Since the modified invention of Zhang does not limit the amount etched with the TMAH, it would have been obvious to one of ordinary skill in the art at the time of invention was made, to select any desirable range, because Zhang does not limit the thickness to be etched. One of ordinary skill would select any thickness desired to be etched in the anisotropic etch step, including applicants' specifically claim range.

As to claims 21 and 22, Zhang discloses a step of coating a thin metal film on the silicon mirror (see col.8, line 64-65).

Claim Rejections - 35 USC § 103

Claim 6 is rejected under 35 U.S.C. 103(a) as being unpatentable over Zhang and Miller et al, as applied to claims 1-5, 12-15, and 21-22 above, and further in view of

Kim et al. (Characterization of the Post Dry-Etch Cleaning of Silicon for Ti-Self-Aligned Silicide Technology; J. Electrochem. Soc., Volume 146, Issue 4, pp. 1549-1556; April 1999)

Zhang fails to teach oxygen plasma is irradiated to the substrate in the cleaning step, as in claim 6.

Kim et al. teaches oxygen plasma is used to clean the silicon substrate after dry etching (see abstract).

It would have been obvious to one of ordinary skill in the art at the time of invention was made, to modify the invention of manufacturing micro-mirrors, as in Zhang, to include the step of oxygen plasma to clean the silicon substrate, as in Kim et al., because Kim et al. illustrates it is an effective method of cleaning silicon substrates.

Claim Rejections - 35 USC § 103

Claim 7 is rejected under 35 U.S.C. 103(a) as being unpatentable over Zhang and Miller et al, as applied to claims 1-5, 12-15, and 21-22 above, and further in view of Raynaud et al. (Cleaning of silicon surfaces by argon microwave multipolar plasmas excited by distributed electron cyclotron resonance; Journal of Vacuum Science & Technology B: Microelectronics and Nanometer Structures -- May 1993 -- Volume 11, Issue 3, pp. 699-708).

Zhang fails to teach argon plasma is irradiated to the substrate in the cleaning step, as in claim 7.

Raynaud illustrates argon plasma is irradiated to the substrate to clean silicon (see abstract).

It would have been obvious to one of ordinary skill in the art at the time of invention was made, to modify the invention of manufacturing micro-mirrors, as in Zhang, to include the step of argon plasma to clean the silicon substrate, as in Raynaud et al., because Raynaud et al. illustrates it is an effective method of cleaning silicon substrates.

Claim Rejections - 35 USC § 103

Claim 8 is rejected under 35 U.S.C. 103(a) as being unpatentable over Zhang and Miller et al, as applied to claims 1-5, 12-15, and 21-22 above, and further in view of Atobe et al. (6,271,955).

Zhang fails to teach the substrate is immersed in a liquid mixture of sulfuric acid and an aqueous hydrogen peroxide in the cleaning step, as in claim 8.

Atobe et al. illustrates the substrate is immersed in a liquid mixture of sulfuric acid and an aqueous hydrogen peroxide when the resist is removed (i.e. in the cleaning step) (see col. 16, lines 8-13).

It would have been obvious to one of ordinary skill in the art at the time of invention was made, to include the step of substrate is immersed in a liquid mixture of sulfuric acid and an aqueous hydrogen peroxide, as Atobe et al., for the cleaning step, of Zhang, because Atobe et al. illustrates the chemistry is effective for cleaning a silicon substrate.

Claim Rejections - 35 USC § 103

Claim 9 is rejected under 35 U.S.C. 103(a) as being unpatentable over Zhang and Miller et al, as applied to claims 1-5, 12-15, and 21-22 above, and further in view of Pfoff (4,816,031).

Zhang fails to teach the substrate is immersed in a heated sulfuric acid in the cleaning step, as in claim 9.

Pfoff illustrates the substrate is immersed in a heated sulfuric acid in the cleaning step (see col.5, lines 65-67).

It would have been obvious to one of ordinary skill in the art at the time of invention was made, to include the step of substrate is immersed in a liquid mixture of sulfuric acid and an aqueous hydrogen peroxide, as Pfoff, for the cleaning step, of Zhang, because Pfoff illustrates the chemistry is effective for cleaning a silicon substrate.

Claim Rejections - 35 USC § 103

Claim 10 is rejected under 35 U.S.C. 103(a) as being unpatentable over Zhang and Miller et al, as applied to claims 1-5, 12-15, and 21-22 above, and further in view of Mansel et al. (6,108,121).

The modified invention of Zhang illustrates the anisotropic etchant but fails to teach use of potassium hydroxide (KOH) as in claim 10.

Mansel et al. illustrates effective interchangeable chemistries for the anisotropic wet etch processes can be KOH or TMAH (see col.12, lines 6-7).

It would have been obvious to one of ordinary skill in the art at the time of invention was made, to include KOH is interchangeable for TMAH for anisotropic etching, as Mansel et al., when manufacturing a mirror, as Zhang and Miller, because Mansel et al. illustrates KOH is effective when interchanged with TMAH.

Claim Rejections - 35 USC § 103

Claim 11 is rejected under 35 U.S.C. 103(a) as being unpatentable over Zhang and Miller et al, as applied to claims 1-5, 12-15, and 21-22 above, and further in view of Bolle et al. (6,912,081).

The modified invention of Zhang does not teach the anisotropic wet etchant is KOH with isopropyl alcohol as in claim 11.

Bolle illustrates an anisotropic wet etchant of KOH or TMAH with isopropyl alcohol (see abstract) (col. 4, lines 60-67) is compatible with processing.

It would have been obvious to one of ordinary skill in the art at the time of invention was made, to include the use of KOH (or TMAH) with isopropyl alcohol, as Bolle, for anisotropic wet etchant, as the modified invention of Zhang, because Bole illustrates the chemistry is compatible with the process step of anisotropic wet etching.

Claim Rejections - 35 USC § 103

Claim 17 is rejected under 35 U.S.C. 103(a) as being unpatentable over Zhang and Miller et al, as applied to claims 1-5, 12-15, and 21-22 above, and further in view of Cunningham et al. (2002/0086456) evidenced by a MSDS for TMAH (http://nanotech.wisc.edu).

Although, the modified invention of Zhang teaches the anisotropic wet etchant has TMAH, it is silent as to the presence of ammonia in the etchant, and fails to teach the presence of arsenic oxide in the etchant.

However, it would have been obvious to one of ordinary skill in the art at the time of invention was made, to include the presence of ammonia in the etchant TMAH, as in applicants' limitation of claim 17, because ammonia is inherently present as a hazardous decomposition product of TMAH (see MSDS for TMAH, pg. 3).

As for the presence of arsenic oxide in the etchant, Cunningham et al. illustrates a method of manufacturing a MEMS mirror which includes the steps of masking the substrate (fig. 2E 47) leaving an area exposed to receive an ion arsenic implant (49); then removing the mask (47); forming an oxide mask (fig. 2F, 53) to cover the recently arsenic implanted area (49); anisotropically etching the oxide that was residing on the arsenic area (where 53 touched 49) with TMAH (see para. 51-52) which is then presents arsenic oxide into the etchant.

It would have been obvious to one of ordinary skill in the art at the time of invention was made, to modify the invention of forming a mirror, as in the modified

invention of Zhang, to include that arsenic oxide is present in the etchant, as Cunningham, because Cunningham illustrates the removal of arsenic oxide during the etch process, which would intrinsicly be presented into the etchant (i.e. a presence of arsenic oxide in the etchant).

Claim Rejections - 35 USC § 103

Claim 18 is rejected under 35 U.S.C. 103(a) as being unpatentable over Zhang and Miller et al, as applied to claims 1-5, 12-15, and 21-22 above, and further in view of Powell et al. (Anisotropic Etching of 110 and 110 planes in 100 silicon; Journal of Micromechanics and Microengineering; 11, 2001, 217-220)

The modified invention of Zhang does not teach the crystal face on the surface of the substrate is {100} face, and the crystal face as the reflection surface is {100} face or {110} face.

Powel et al. teaches the crystal face on the surface of the substrate is {100} face, and the crystal face as the reflection surface is {100} face or {110} face (see figure 1).

It would have been obvious to one of ordinary skill in the art at the time of invention was made, to modify the invention of forming micro-mirrors, as Zhang, to include crystal face on the surface of the substrate is {100} face, and the crystal face as the reflection surface is {100} face or {110} face, as , because

illustrates these structures are producible.

Claim Rejections - 35 USC § 103

Claim 19 is rejected under 35 U.S.C. 103(a) as being unpatentable over Zhang and Miller et al, as applied to claims 1-5, 12-15, and 21-22 above, and further in view of Holke et al. (Ultra-deep anisotropic etching of 110 silicon; Journal of Micromechanics and Microengineering; 9, 1999; 51-57)

The modified invention of Zhang does not teach the crystal face in the surface of the substrate is {110} face, and the crystal face as the reflection surface is {100} face, {110} face, or {111} face, as in claim 19.

Holke et al.teaches the crystal face in the surface of the substrate is {110} face, and the crystal face as the reflection surface is {110} face and {111} face.

It would have been obvious to one of ordinary skill in the art at the time of invention was made, to modify the invention of forming micro-mirrors, as Zhang, to include crystal face on the surface of the substrate is {110} face, and the crystal face as the reflection surface is {110} face or {111} face, as Holke et al., because Holke et al. illustrates these structures are producible.

Claim Rejections - 35 USC § 103

Claim 20 is rejected under 35 U.S.C. 103(a) as being unpatentable over Zhang and Miller et al, as applied to claims 1-5, 12-15, and 21-22 above, and further in view of Cho et al. (2002/0102059).

The modified invention of Zhang does not teach the crystal face in the surface of the substrate is {111} face, and the crystal face as the reflection surface is {110} face, as in claim 20.

Cho et al. teaches the crystal face in the surface of the substrate is {111} face, and the crystal face as the reflection surface is {110} face.

It would have been obvious to one of ordinary skill in the art at the time of invention was made, to modify the invention of forming micro-mirrors, as Zhang, to include crystal face on the surface of the substrate is {111} face, and the crystal face as the reflection surface is {110} face, as , because illustrates these structures are producible.

Claim Rejections - 35 USC § 103

Claim 23 is rejected under 35 U.S.C. 103(a) as being unpatentable over Zhang and Miller et al, as applied to claims 1-5, 12-15, and 21-22 above, and further in view of Little et al. (6639572).

The modified invention of Zhang does not teach the thin film is formed of a dielectric material, as in claim 23.

Little et al. illustrates it is known and purposeful to coat a dielectric layer on a mirror surface, as in claim 23 (see col. 11, lines 11-18).

It would have been obvious to one of ordinary skill in the art at the time of invention was made, to modify the invention of forming micro-mirrors, as Zhang, to include forming a dielectric layer on the reflective surface layer, as Little et al., because Little et al. teaches the presence of the dielectric layer on the mirror plays a role in relieving the intrinsic stress of the mirror (see col. 11, lines 11-18).

Claim Rejections - 35 USC § 103

Claim 24 is rejected under 35 U.S.C. 103(a) as being unpatentable over Zhang and Miller et al, as applied to claims 1-5, 12-15, and 21-22 above, and further in view of Nakayama et al. (6,852,362).

The modified invention of Zhang is silent as to the method of thin film deposition an oblique vapor deposition method, in the step of coating the thin film on the reflection surface, as in claim 24.

Nakayama illustrates film deposition method for thin film an oblique vapor deposition method using a vacuum vapor deposition method in the step of coating the thin film on the reflection surface (see abstract).

It would have been obvious to one of ordinary skill in the art at the time of invention was made, to modify the invention of forming micro-mirrors, as Zhang, to include a method for thin film an oblique vapor deposition, as Nakayama, because Nakayama teaches the method enhances stability of the deposited layer (see background).

Claim Rejections - 35 USC § 103

Claim 25 is rejected under 35 U.S.C. 103(a) as being unpatentable over Zhang and Miller et al, as applied to claims 1-5, 12-15, and 21-22 above, and further in view of Seshan (Handbook of Thin-Film Deposition Processes and Techniques - Principles, Methods, Equipment and Applications; released 10/2001; William Andrew publishing/Noyes)

The modified invention of Zhang is silent as to the deposition method used for the thin film is a sputtering method, as in claim 25.

Seshan illustrates thin films are commonly sputtered (see page 475, section 5.0 Applications).

It would have been obvious to one of ordinary skill in the art at the time of invention was made, to modify the invention of forming micro-mirrors, as Zhang, to include the deposition method used for the thin film is a sputtering method, as Seshan, because Seshan illustrates sputtering a common method of thin film deposition.

Claim Rejections - 35 USC § 103

Claim 26 is rejected under 35 U.S.C. 103(a) as being unpatentable over Zhang and Miller et al, as applied to claims 1-5, 12-15, and 21-22 above, and further in view of Wikipedia (http://en.wikipedia.org/wiki/Thin-film_deposition)

The modified invention of Zhang is silent as to the film deposition method for the thin film is a plating method, as in claim 26.

Wikipedia illustrates plating is a commonly used thin film deposition method (see page 1).

It would have been obvious to one of ordinary skill in the art at the time of invention was made, to modify the invention of forming micro-mirrors, as Zhang, to include the method of thin film deposition is plating, as Wikipedia, because Wikipedia illustrates plating is a commonly used method of deposition.

Claim Rejections - 35 USC § 103

Claim 27 is rejected under 35 U.S.C. 103(a) as being unpatentable over Zhang and Miller et al, as applied to claims 1-5, 12-15, and 21-22 above, and further in view of Society of Vacuum Coaters (SVC) (44th Annual Tech Conference Proceedings; 2001; Society of Vacuum Coaters).

The modified invention of Zhang is silent as to the method for thin film deposition is ion plating, as in claim 27.

SVC illustrates ion plating is a commonly used method of depositing films (see abstract).

It would have been obvious to one of ordinary skill in the art at the time of invention was made, to modify the invention of forming micro-mirrors, as Zhang, to include the method for thin film deposition is ion plating, as SVC, because SVC illustrates is it a commonly used process.

Allowable Subject Matter

Claim 16 objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims. The following is a statement of reasons for the indication of allowable subject matter: The closes prior art does not disclose or suggest a method for manufacturing a mirror using an etchant with additive of silicon and ammonium persulfate in TMAH for an anisotropic wet etch step.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Patricia A. George whose telephone number is (571)272-5955. The examiner can normally be reached on weekdays between 7:00am and 4:30pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nadine Norton can be reached on (571)272-1465. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

PAG
06/06

Patricia A George
Examiner
Art Unit 1765

NADINE NORTON
SUPERVISORY PATENT EXAMINER